4.

External Characters of Six Embryo Nurse Sharks, *Ginglymostoma cirratum* (Gmelin).[1]

William Beebe

(Plates I & II; Text-figures 1–4).

Six embryo nurse sharks, *Ginglymostoma cirratum* (Gmelin), taken from a single female, have been kindly loaned to me for the study of external characters, by Commodore William K. Vanderbilt. They are borrowed from his marine museum at Huntington, Long Island, and were obtained from Mr. Louis L. Mowbray. The parent was said to be about five feet in length, and was caught in Bermuda. It was not possible to stain or section the specimens, as I agreed to return the embryos in their present condition.

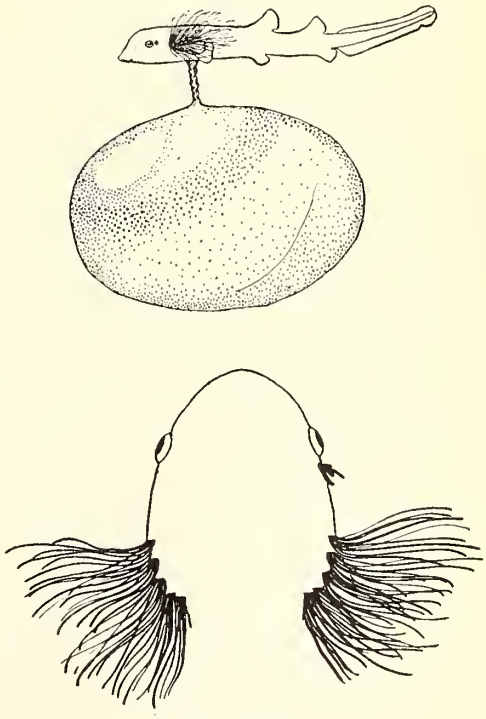
The material consists of six embryos which I have designated as A to F. They are nicely graduated as to size and degree of development, and in total length measure from 73 to 152 mm. They are free, in the sense of being without shells or egg-cases, but each is attached by a short, twisted, umbilical-like extent of tissue with a large, rounded or oval mass of yolk.

In his recent monograph on *Chlamydoselachus* (Bashford Dean Memorial Volume Archaic Fishes, Article VII, American Museum, N. Y.), Dr. E. W. Gudger writes, "The tropical, shallow-water nurse shark, *Ginglymostoma cirratum* carries in each greatly dilated uterus as many as 21 huge, thick-shelled eggs." As regards the subsequent history of these uterine eggs, Gudger on strong circumstantial evidence believes that this shark is ovoviviparous, and that when the young are pretty well developed, they break out of their shells, and these latter are cast out while the embryos are retained in the uteri during further development. A photograph of one of the unbroken egg-cases, 140 mm. long, is shown on page 560 of the Memorial Volume.

The total lengths of the six embryos under consideration are as follows: Embryo A, 73 mm.; B, 104; C, 107; D, 125; E, 138, and F, 152 mm. The relationship by weight of embryo to yolk is from 5.7% to 33%.

In embryo A the fin-folds are still sufficiently in evidence to confuse any fin base measurements. The first dorsal is joined to the second dorsal, and this to the caudal, by the continuation of the fin in a groove beneath the surface profile of the body. The same is true of the anal which extends forward in a subdermal groove to the vertical of the pelvics. The translucent dorsal fins in this smallest embryo show thirteen incipient rays in the first, and ten in the second.

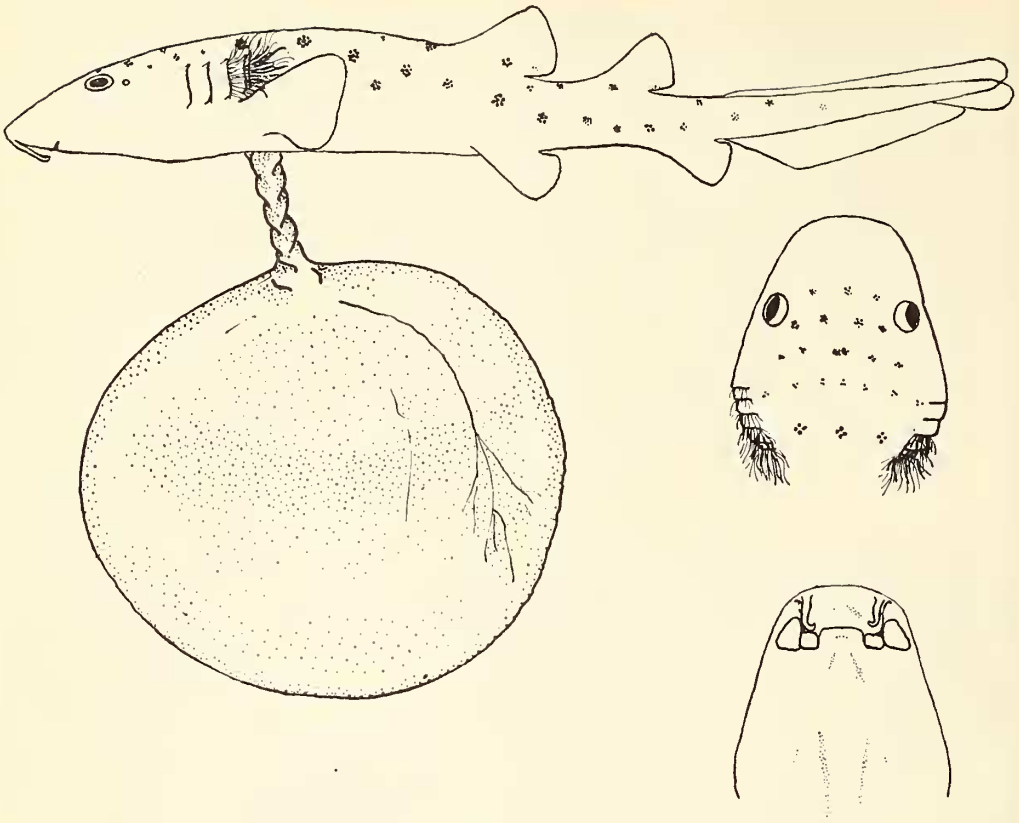
External gills are present in all but embryo F, the largest. There is a gradual absorption in length of these filaments in the first five speci-



Text-figure 1.

Embryo A, length 73 mm. Side view with yolk sac (×3/5). Dorsal view of head showing external gill filaments from spiracle and gill-slits. (×6).

[1] Contribution No. 612, Department of Tropical Research, New York Zoological Society.
Contribution from Bermuda Biological Station for Research, Inc.



Text-figure 2.

Embryo D, length 125 mm. Side view with yolk sac. Dorsal and ventral views of head.

mens. This is evident in the relationship percentage between gill filaments and total lengths, 20%, 9.6%, 8%, 4.5%, and 3%. The smallest embryo shows the interesting condition of four external gill filaments projecting from the right spiracle, the longest of which measures 1.7 mm. in length. None are visible in the left spiracle.

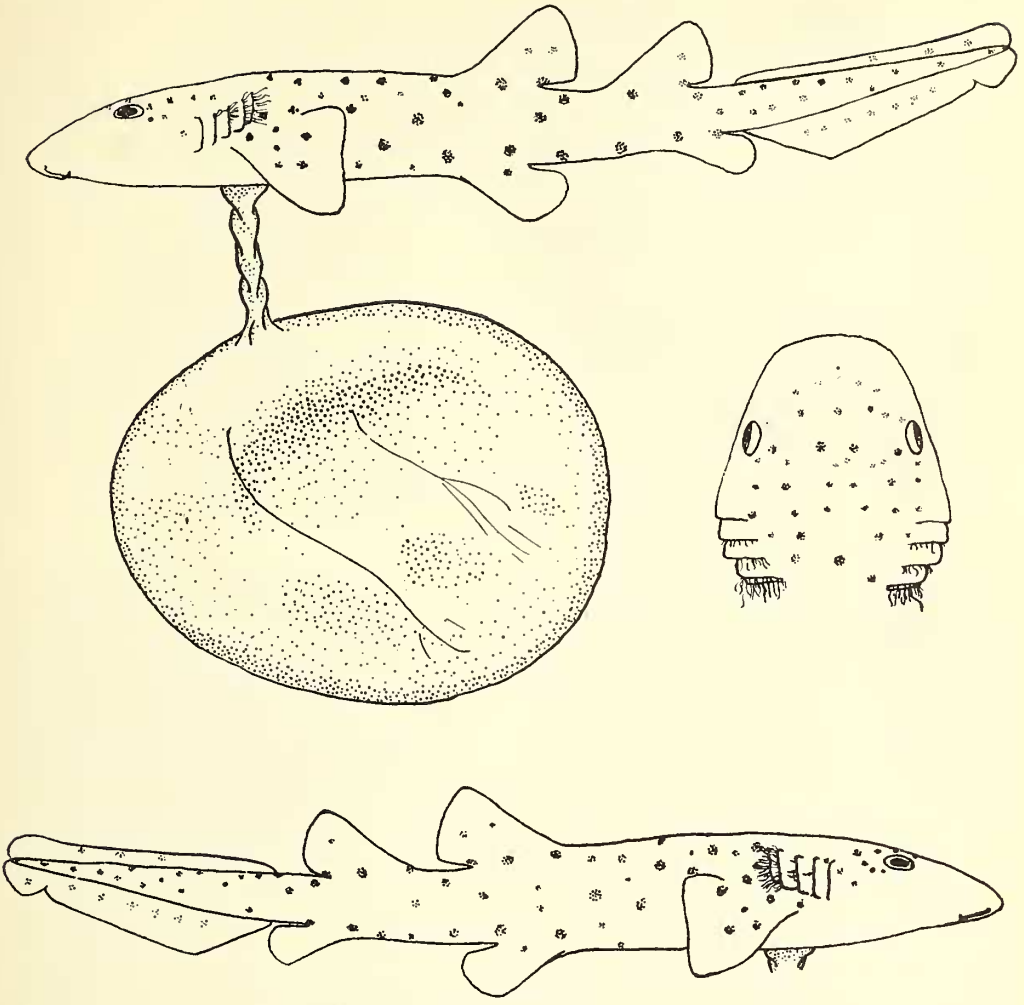
In the same smallest nurse shark embryo the anterior or first gill-slit shows twenty-six long filaments and a cluster of short ones at the top of the slit. A progressively larger number spring from the next three slits, while the fifth, which is directly below the fourth, has only four filaments, these, however, being of greater length than any of the rest. This general relationship holds good for the larger embryos.

The climax of numerical development of external gill filaments occurs in D, the 125 mm. individual. The next larger, with a total length of 138 mm., has lost all the filaments from the left first and second slits, although they are present on the right side. In E, of 138 mm., this asymmetry is reversed, the right anterior slits being free. The filaments are absorbed from below upward, the last to disappear being close to the dorsal ends of the slits. Those from the fourth and fifth slits are the final ones to vanish. F, of 152 mm. length, shows no external evidences of filaments. In the two youngest embryos the fifth slit is directly beneath the fourth, but from here on to the adult shark, it is slightly behind the fourth.

As to color and pattern, the 73 mm. embryo is unspotted, as are full-grown sharks. Spots first appear, although weak and sparse, in the 104 mm. individual, and increase in strength and number up at least to embryos of 152 mm. length. In 300 mm., free-swimming nurse sharks the spots are small or obscured by the general dark pigmentation. A 385 mm. specimen taken on the *Zaca* expedition, is immaculate.

Detailed examination shows that the pattern of spots can be quite asymmetrical (specimen C, with seven spots on the right side of the body, and fifteen on the left side); or symmetrical (specimens C, E and F, with numerous transverse bands on the head and body), or somewhat irregular (specimen G). Coppery color is apparent in the irides of the 152 mm. individual.

The smallest and largest of seven specimens (including the six embryos, and a 385 mm. free-swimming young shark), are females. Claspers are evident in all the rest. In the 104 mm. embryo they are 4.5 mm. long, wholly attached



Text-figure 3.

Embryo E, length 138 mm. Right and left side views with yolk sac. Dorsal view of head.

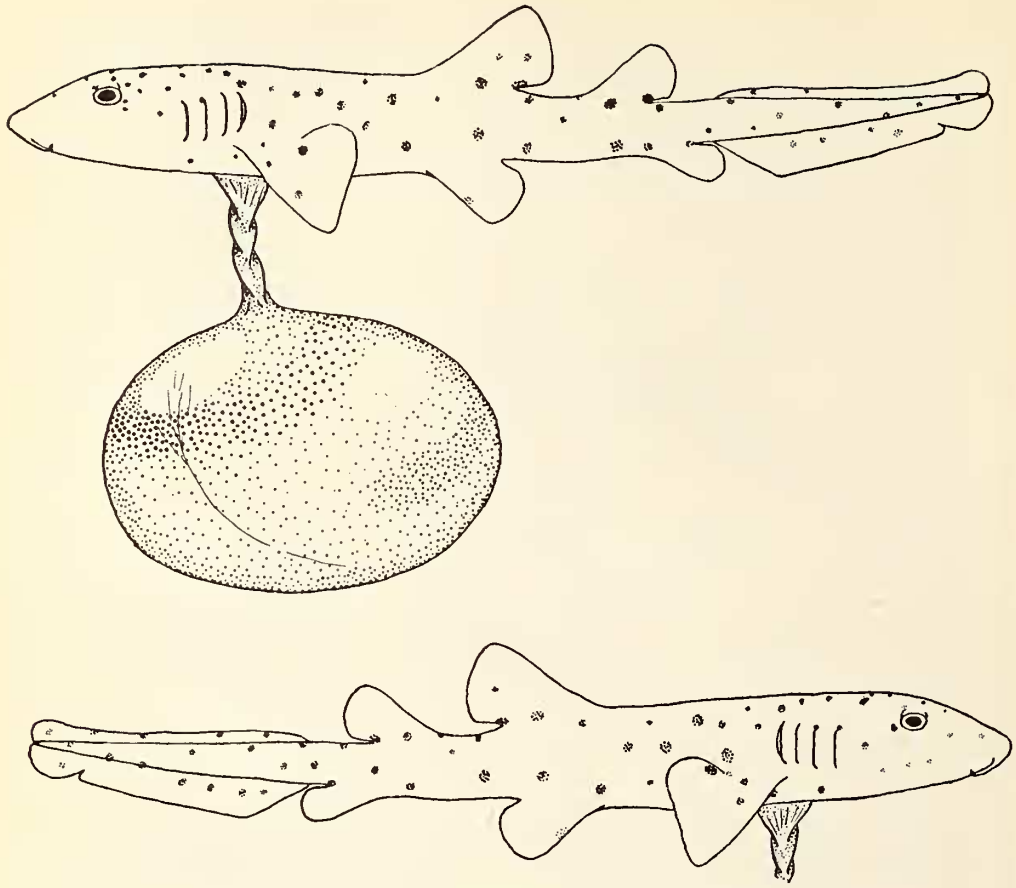
to the inner edge of the pelvic fins, and extending to within 1 mm. of the posterior rim of these fins. There is a gradual increase in size until in the 385 mm. shark the claspers are 13 mm. long, 9 mm. below the posterior fin border, and free for 6 mm. of their length.

As the cirri or tentacles develop, their tips curve around and down, into the corners of the mouth, inside the lateral flap. This condition also holds in the young, free-swimming sharks, the tentacles being thus partly hidden and protected when not in use.

In the course of embryonic development of *Ginglymostoma* from an embryo of 73 mm. to a full-grown shark of 2,090 mm. total length, we find there are six characters showing a percentage of increase relative to the total length, and seventeen which are on the minus side. The body depth is somewhat greater in the adult, the general flattening being especially noticeable in unborn individuals. The head, both in length and width, snout, preoral, interorbital and internarial, all show relative reduction in the adult, as much as 3.7% in head length, and 4.4% in the snout. The mouth width, on the contrary, is slightly greater.

The eye, length of tentacle and of spiracle are markedly less in the full grown shark. The heights of the three median fins, first and second dorsals and anal enlarge steadily from early embryo onwards, even reaching a 4.6% increase. The pectorals exceed these, registering width and length increases of 5.7% and 7.6%.

There is considerable reduction in antero-posterior measurements from snout to first and second dorsals, as well as to pectorals, pelvics and anal fins. The bases of all the median fins are relatively less in the adult, partly because of the slow disappearance of the fin-fold.



Text-figure 4.

Embryo F, length 152 mm. Right and left side views with yolk sac.

We may safely deduce that throughout the life of this shark there is an increasing need for large pectorals and a general flattening of the body in relation to the bottom-living habits, while correlated with this is a reduction of the head, with its tentacles, eyes and spiracles, and a relative shortening of the whole body. In fact, *Ginglymostoma* tends in development rather toward a bottom-living, ray-like type, than to a mid-water, shark-like organism.

Developmental characters showing a plus percentage in relation to total length are these: depth 2%, pectoral length 7.6%, pectoral width 5.7%, first dorsal height 4.6%, second dorsal height 2.3%, anal height 1.3% and mouth width 1%. Characters showing minus percentage in development are head 3.7%, head width 1.7%, snout 4.4%, interorbital 4.6%, eye 2%, snout to first dorsal 4.6%, snout to second dorsal 3%, snout to pectoral 4.6%, snout to pelvics 5.2%, snout to anal 3.6%, first dorsal base 2.1%, second dorsal base 2.3%, anal base 3.1%, snout to mouth 2.6%, tentacle length 2.5%, internarial 1.3% and spiracle length .5%.

EXPLANATION OF THE PLATES.

Plate I.

Fig. 1. Embryo B, length 104 mm. Shark, showing external gill filaments and yolk sac.

Fig. 2. Embryo D, length 125 mm. Shark, showing right side and yolk sac.

Plate II.

Fig. 3. Embryo F, length 152 mm. Dorsal and right side views and yolk sac.

Fig. 4. Embryo F, length 152 mm. Ventral view and yolk sac.